STATE & PRIVATE FORESTRY
FOREST HEALTH PROTECTION
SOUTH SIERRA SHARED SERVICE AREA

Report No. SS13-01

21st October 2112
File No. 3420

To: **Nancy Gibson, LTBMU, Forest Supervisor.**
Bob Becker, LTBMU, Recreation specialist.

From: Forest Health Protection, South Sierra Shared Service Area.

Re: Assessment of the failure of a 22 inch white fir in the Bayview Campground, LTBMU.

Summary.

As concerns for the safety of the visitors to our campground is taken so seriously by the FHP, an initial evaluation of the failed tree was made on the first workday after the report of the tree failure. My evaluation of the failure was identical to that of recreational specialist Becker's. In our opinions the tree failed as a result of a chronic infection by Heterobasidion root disease caused by the fungus ***Heterobasidion occidentale*** (aka the "S" or fir type of Annosus).

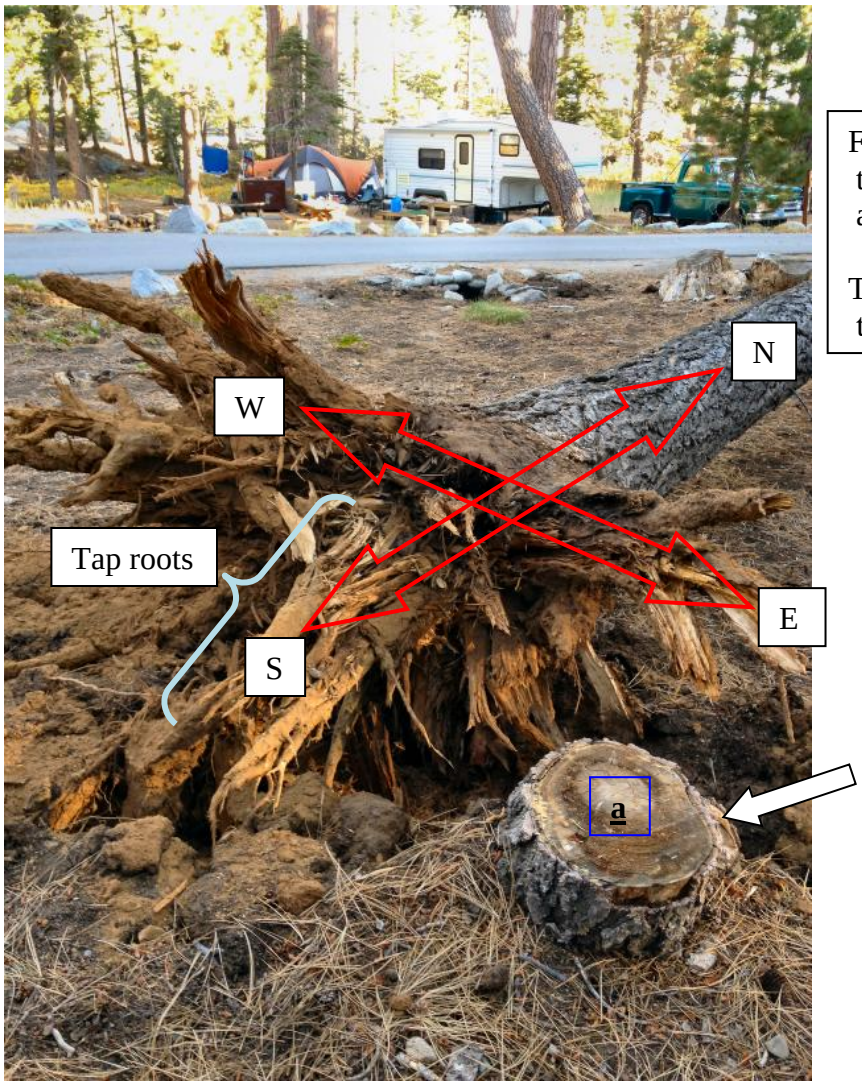
While an inspection of the rest of the campground provided plentiful evidence of the presence of a chronic and extensive infestations of the campground by Heterobasidion root disease it did not highlight any individual fir tree with a higher probability of failure than any other.

Based on my observation of this and other campgrounds in the Basin the probability is that the next tree to fail will be in some campground other than Bayview and there is a high probability that it will also be a white fir. This opinion based on the observation that this disease is at epidemic proportions within the South Sierran forests.

Finally FHP strongly encourages the continued and aggressive use of Sporax or Cell-u-treat (to Regional Office standards) in conjunction with all takedowns in the Basin's campgrounds. Should the Basin require Hazard Tree awareness or Sporax trainings for employees, FHP is available to provide them (no job code needed).

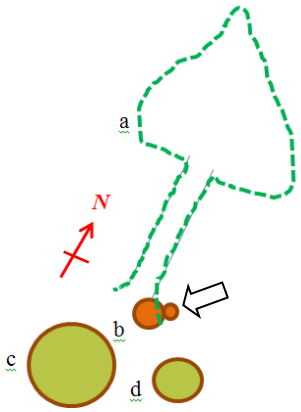
The Becker Photograph (Fig 1).

To facilitate an explanation for the failure of this tree I have used Bob's photograph and assigned (arbitrarily) 4 cardinal axes. Thus for this discussion the tree is considered to have fallen to the North.



For purposes of this discussion, the N axis was arbitrarily taken as the direction in which the tree fell.

This was done to facilitate discussing the fallen tree's roots in 4 quadrants .



a Fallen tree
b Stump a
c Ponderosa
d Lodgepole

Figure 1. Recreational specialist Becker's initial image sent from his cell phone. Various letters are explained within the text.

As this tree failed under generally calm conditions why did the tree not fail the last time the wind blew ?

What can not be seen in the Becker photograph are a 42 inch Ponderosa and a 22 inch Lodgepole pine standing just to the south of the fallen tree. The crowns of theses tree would have shielded the fallen from any wind blowing from the south. As will be seen later this tree failed towards the North, because it had few (if any) mechanically functional roots towards the South

If the tree had few functioning roots to the South why did its crown appear to be in fair condition?

The roots of a tree have 3 functions, one is to take water and nutrients to the crown (leaves), two is for storage of carbohydrates (especially important in deciduous tree) and three is a structural function. As the direction of growth and development of roots is in response to the availability of water and oxygen, this tree would have its strongest root development to the North, because there were 2 other competing

trees to the South. I know little about the health of the roots to the North, however I do know that they did not fail. Work I have done with Armillaria root rot had shown me that trees can get enough water to keep their crown looking healthy even after the root rot has killed over half of their roots. However, a tree can not remain standing for long after a root rot has destroyed over half of its roots. Root rots frequently compromise the mechanical integrity of a tree long before they cause any easily detectable crown symptoms. In truth, were we to have measured radial growth using several increment cores we might have been able to detect a growth decline in the years before failure. Had this been an infected pine we might have been able to detect a reduction in needle length in the year before failure.

Mode of failure.

I speculate that the roots in the Southern quadrant failed (due to root rot) and the roots of the East – West axis acted as a hinge line thus allowing the tree to fold over on its North quadrant roots. While the N quadrant roots have the tensile strength to prevent a wind from the N blowing the tree over they do not have the strength to hold (*push)* the tree upright.

Evidence for root rot.

Tap roots. Although the top sections of the taproots (seen in figure 1) did not break off (they simply pulled out of the soil) they were badly rooted and the growth rings were delaminated and retained little of their original strength, see fig 2. In this tree the tap roots no longer function in conduction of water, storage of carbohydrates or provide any structural support to the tree.

Figure2. A section of the tap root showing delamination (de-lam) where the fungus has digested away the early wood of the annual rings.

Southern quadrant root(s). The remnant of the one major root in the southern quadrant was sawn of with a folding saw and photographed (figure 3). Print outs of the image were used to estimate that over 70% of the roots cross sectional area was either badly decayed or totally missing. Because the outer shell is breached the residual strength may well have been reduced below 30% of its previous level. Regardless of this previous speculation we know that the residual strength, at the time of failure had fallen below the minimum that was needed to keep the tree upright on a calm day.

Figure 3 Cross section of the only root on the southern quadrant that remained indefinable as a partially functional root. The area within the circle is considered decayed and or missing.

Eastern and western quadrant roots. The western quadrant roots are shown in figure 4, where they too were sawn of to expose the white arcs of living sapwood, some residual functional heartwood and a lot of rotted wood. This image begs the question; "Why didn't this tree fail a lot earlier considering how little sound roots it had? In truth, I do not know!

Figure 4 The roots of the Western quadrant & the southern quadrant root of (fig 3) is marked with white block arrow. The arcs of white wood indicate living sap wood with the brown areas being dead and largely decayed.

Evidence for suggesting that Heterobasidion root diseases is prevalent in this campground. On my first visit to the campground I parked my vehicle up by the horse corral and on my way to find the fallen tree, three of the first four stumps I looked at were of white fir and badly Heterobasidion decayed. While this pathologist does not usually call a root rot centre, Heterobasidion, without seeing a conk, in the case of a campground site we can not afford to take the risk involved in waiting for the fungus to fruit. In the absence of conks we must make decisions based upon a preponderance of the evidence.

In his telephone conversation with me, Bob Becker pointed out that the fallen tree had come to rest upon the tipped up stump of another white fir that appeared to have failed (earlier) in a similar manner. Examination of that stump was consistent with a Heterobasidion diagnosis. In bob's photograph (fig1) another cut fir stump (white arrow) can be seen. Within about 12 ft of the fallen tree I counted 10 white fir stumps many of which displayed the delaminated rot so characteristic of this decay (figure 5). Some of the decay patterns were so characteristic of this fungus that samples were taken back to Sonora to be added to the Service Area's teaching collection.

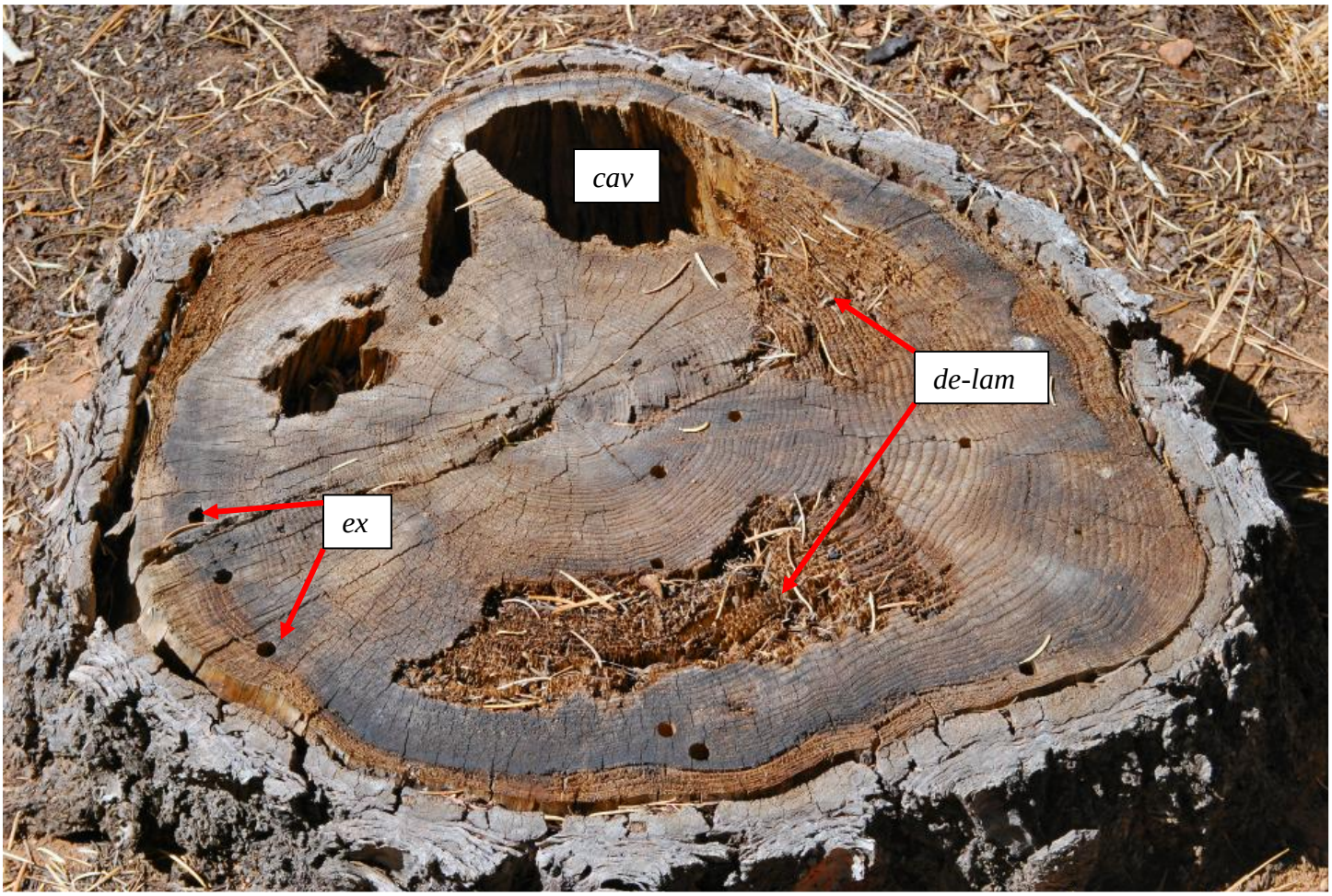


Fig 5. One of many stumps in the campground that was photographed to show symptoms associated with Heterobasidion root disease. (*cav*) cavity in which conks typically develop, (*de-lam*) delamination's typical of Heterobasidion decay; (*ex*) exit hole of a longhorned borer showing that (post felling) the stump resources had been portioned between a fungus and an insect

The fact that 10 white fir had previously been removed and an eleventh had failed in the vicinity of the failed tree provides supportive evidence for my suggestion that this root rot has been, and will continue to be, a chronic problem (in this campground at least). The ponderosa and lodgepole pines are immune from

this disease and the Heterobasidion species (P type) that infects pines and incense cedar has never been reported from the Basin. This disease is slowly causing a species conversion to anything other than white fir.

Firs that share a root system share a disease. Returning to Bob's image (figure1) I would like to focus on the stump marked ***a*** and the white blocked arrow (⇦)adjacent to it. For a larger and clearer view of this region see figure 6. The root systems of white fir have a great propensity to graft to each other. When the small tree or lateral branch (marked with the white blocked arrow was cut it did not die, it was kept alive by either tree ***a*** or the tree that subsequently failed. This we know because there is a callus ring around the stump. The number annual rings in the callus ring indicate the number of years the stump stayed alive after being cut. After the arrowed stump was cut any successfully germinating Heterobasidion spores would be able to grow down the stump and through the grafted root system gain access to an adjacent tree, be it tree ***a*** or the failed tree, depending upon how many inter-tree grafts were present . It is to break this step in transmission of the disease that we apply borate dressings to all cut stumps (over 3inches) in a campground. The borate dressing kills the spores as they try to germinate and thus protects adjacent living trees that would otherwise be infected via root grafts. Failure to apply a borate dressing in a timely manner allows this fungus to increase its hold on our campgrounds, but the damage may take years to become apparent

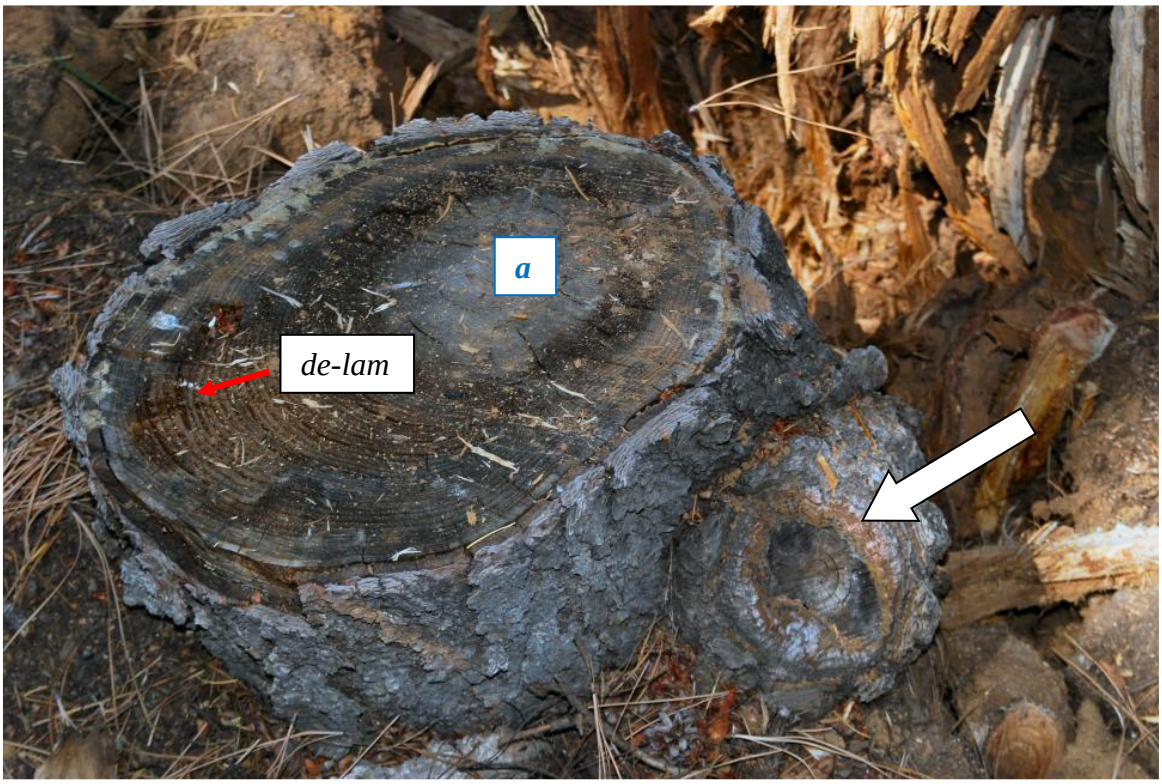


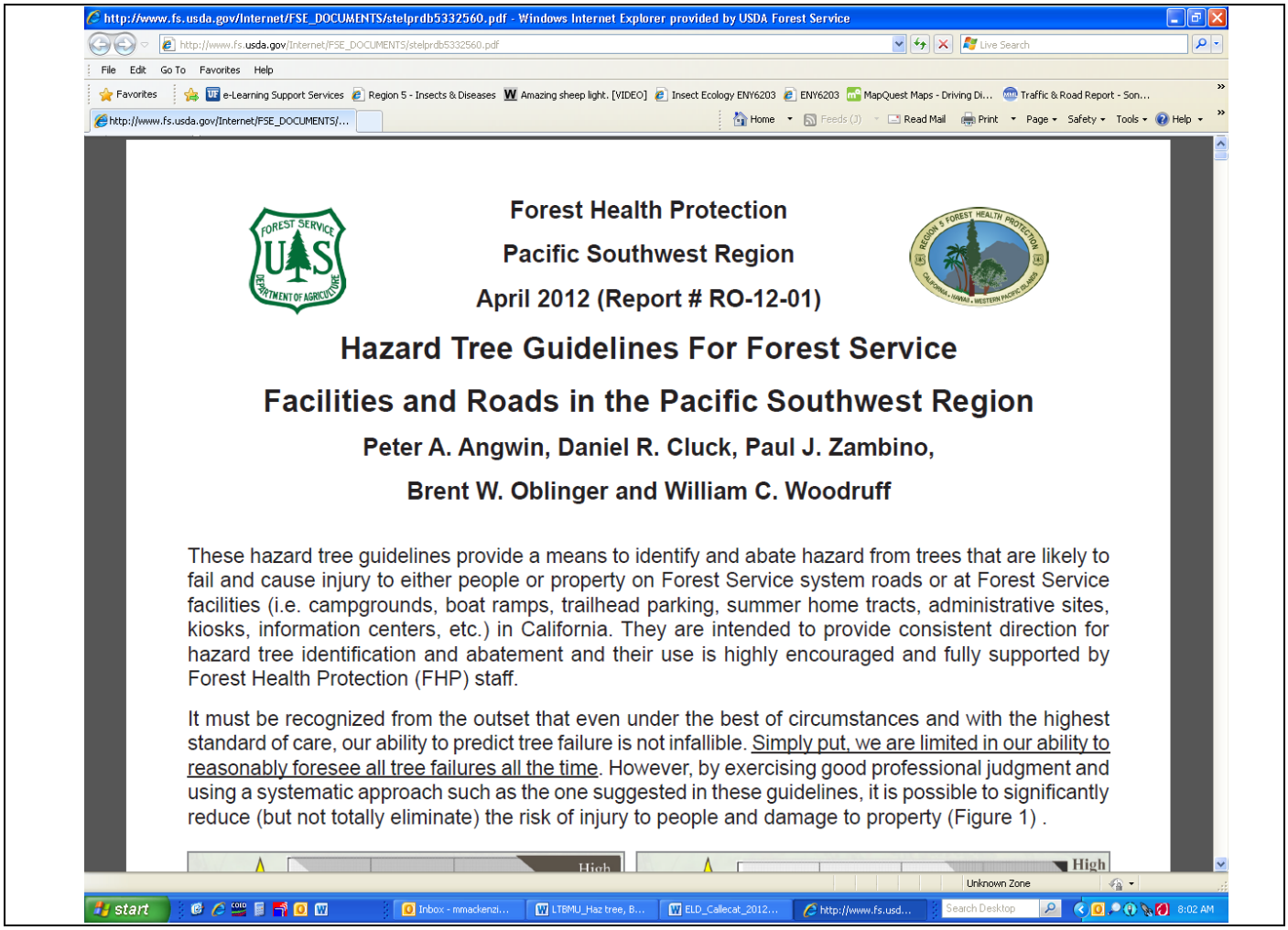
Figure 6. Closest stump to the failed tree, see figure 1 for orientation to the failed tree.

Conclusion. I conclude that the tree failed as a consequence of a chronic Heterobasidion root disease infection. While I'm convinced that several more trees in the campground are also infected I saw no trees currently exhibiting symptoms that would support their immediate removal. However, I strongly support, documented, annual, inspections of all trees in the campground plus a mid-summer walk through. For all campsites near the boundaries I would encourage inspection beyond the boundary to at least one-tree height.

While it is reasonable to assume there is more disease in the campground, FHP strongly recommends a borate application to all stumps of takedown trees. Further FHP urges the LTBMU to continue to follow updated RO guidelines for campgrounds and Sporax application. Having said this, I saw no evidence that the LTBMU's had missed any obvious Hazard Trees and in conversations with Recreational Specialist Becker we agreed upon a couple of "watch trees" in the campground. "Watch trees" are trees that while not hazards at the moment they could become hazards in the future, and when they cross that threshold the LTBMU will take the appropriate action to ensure the continued safety of our visitors.

Appendix A Web site for R05, FHP, Hazard Tree Guidelines

http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5332560.pdf


http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5332560.pdf - Windows Internet Explorer provided by USDA Forest Service
Forest Health Protection
Pacific Southwest Region
April 2012 (Report # RO-12-01)
Hazard Tree Guidelines For Forest Service
Facilities and Roads in the Pacific Southwest Region
Peter A. Angwin, Daniel R. Cluck, Paul J. Zambino,
Brent W. Oblinger and William C. Woodruff
These hazard tree guidelines provide a means to identify and abate hazard from trees that are likely to fail and cause injury to either people or property on Forest Service system roads or at Forest Service facilities (i.e. campgrounds, boat ramps, trailhead parking, summer home tracts, administrative sites, kiosks, information centers, etc.) in California. They are intended to provide consistent direction for hazard tree identification and abatement and their use is highly encouraged and fully supported by Forest Health Protection (FHP) staff.
It must be recognized from the outset that even under the best of circumstances and with the highest standard of care, our ability to predict tree failure is not infallible. Simply put, we are limited in our ability to reasonably foresee all tree failures all the time. However, by exercising good professional judgment and using a systematic approach such as the one suggested in these guidelines, it is possible to significantly reduce (but not totally eliminate) the risk of injury to people and damage to property (Figure 1) .
High
High
Unknown Zone
start

Appendix B Web sites relevant to Heterobasidion root disease and borate treatment of stumps.

http://www.fs.usda.gov/detail/r5/forest-grasslandhealth/insects-diseases/?cid=stelprdb5329386

At the above web site can be found links to all of the borate treatment relevant documents listed in the box below. I would suggest that this web-site should be the initial *goto* site for all NEPA investigations involving Sporax

Heterobasidion Information

- R5 Insect & Disease Manual: *Heterobasidion* (pdf 1.9 MB)
- Forest Health Protection Handbook, FSH 3409.11, Chapter 60 (pdf 98 KB)
- Otrosina Heterobasidion taxonomy paper (pdf 1.5 MB)
- Excerpt from *CA Forest Pest Conditions 2009: Heterobasidion* (pdf 2.4 MB)
- Proceedings of the Symposium on Research and Management of Annosus Root Disease (*Heterobasidion annosum*) in Western North America (pdf 1.5 MB)
- Cellu-Treat Information, Product Label, and Material Safety Data Sheets (pdf 356 KB)
- Sporax® Information, Product Label, and Material Safety Data Sheets (follow link, type Sporax into the Brand Name box, click search)
- Human Health and Ecological Risk Assessment for Borax (pdf 621 KB)
- Borax: Frequently Asked Questions (pdf 110 KB)
- Borax Application Training Presentation (pdf 1 MB)
- Written Training Plan for Borax Applicators (pdf 97 KB)
- Region 5 Pesticide-Use Advisory Memorandum 06-01 - Issues with Using Borax for Annosus Root Disease Prevention (pdf 19 KB)
- Attachment to R5 Pesticide-Use Advisory Memorandum 06-01 - Responding to Issues Raised by CATs Concerning Borax (Sporax®) (pdf 392 KB)

Should the Basin require any assistance (now or in the future) with developing any trainings relating to Hazard Trees, Borate treatments (Sporax) their detached FHP office in Sonora is always available to help. Should the inquiry be more of an insect nature the LTBMU Entomologist Beverly Bulaon can be reached at (209) 532 3671 ext 323 or bbulaon@fs.fed.us

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